

**COMPOSITION FOR APPLICATION TO A
FILM FOR HOLDING A FOOD PRODUCT**

CROSS REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of
5 U.S. provisional patent application 60/501,339,
filed September 8, 2003, and U.S. provisional patent
application Serial No. 60/454,444, filed March 13,
2003.

FIELD OF THE INVENTION

10 The present invention relates to composi-
tions for application to a film used as packaging
material for a food product, and to food packaging
films resulting therefrom. In particular, the pres-
ent invention relates to compositions for applica-
15 tion to a tubular food casing, and the resulting
casing, that impart an esthetic brown color to a
foodstuff when the foodstuff is cooked or otherwise
heated within the casing.

BACKGROUND OF THE INVENTION

20 The use of food casings to encase a food-
stuff prior to further processing, such as smoking,
is well known. The traditional smoking process in-
volves stuffing a foodstuff, such as a sausage, into
a smoke-permeable casing, then hanging the stuffed
25 food product in a smokehouse. In the smokehouse,
wood is burned at low temperature to generate smoke.
Smoking by such a traditional technique is labor
intensive, time consuming (e.g., smoking times can

span several days), and the amount of generated smoke often fails to comply with pollution laws.

In order to avoid difficulties associated with the use of smokehouses, packaged meat products have been placed in a heated smoke-free environment for cooking. The process of cooking a foodstuff in a casing by such a method is known as a "cook-in" process. Films for use in the "cook-in" process are referred to as "cook-in" films. However, foodstuffs cooked in this smoke-free manner do not acquire the characteristic brown surface and wood-smoked flavor of a smoked food product.

In order to provide the benefits of a smoked food product, but without the drawbacks of conventional smoking techniques, liquid smoke was developed decades ago. Liquid smoke is the aqueous condensate of a natural wood smoke, and contains phenols, acids, and carbonyl compounds, particularly aldehydes, that react with meat proteins and brown the meat surface. This browning gives the appearance of a naturally smoked food product.

Liquid smoke originally was atomized onto meat products encased in porous natural gut or cellulose casings prior to cooking in an oven. The porosity of the casings allowed the liquid smoke to penetrate the casing and into the meat. In practice, however, it was difficult to provide a uniform coating of the liquid smoke onto the food product by this atomization process.

In view of this difficulty, substantial research was directed to providing a substantially

uniform distribution of liquid smoke on a food product surface. Some attempts were made to incorporate a liquid smoke into the meat product itself. However, this method either provided an insufficient
5 amount of liquid smoke, and in turn browning, on the surface of the foodstuff or imparted an excessive smoky flavor to the food product.

A more successful approach has been to apply a liquid smoke onto a cellulose casing. Techniques for applying liquid smoke onto a cellulose
10 casing include dipping or spraying a liquid smoke solution onto the cellulose casing, such that the liquid smoke on the interior surface of the casing can be transferred to an encased foodstuff. Such a
15 treatment can present difficulties during further processing of the cellulose casings, and, in particular, can interfere with shirring. Despite these difficulties, a number of commercially available liquid smoke-treated cellulose casings exist commercially.
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The permeability and porosity of cellulose casings makes them compatible for use with liquid smoke. However, these properties also introduce serious and widely recognized disadvantages. First,
25 cellulose products are highly permeable to water vapor, which allows moisture loss during cooking and a corresponding decrease in overall weight of the product. A reduced yield of food product results, which is disadvantageous for commercial reasons.
30 Further, cellulose casings are oxygen permeable, which leads to spoiling and/or discoloration of the

food product. Because of this latter difficulty, food products cooked in cellulose casings either are consumed shortly after cooking or are removed from the casings, then rewrapped in an oxygen-impermeable barrier casing as quickly as possible after production. This rewapping step provides an opportunity for contamination or infection of the food product, which represents a loss in quality and shortened shelf life. These additional steps also add to the cost of the food product.

To address the disadvantages of permeable cellulose casings, water and oxygen-impermeable thermoplastic casings were developed. When using a casing of this type, negligible weight loss occurs during the production process or during storage and shipping. Further, the food product remains sterile, provided the casing remains intact. However, as a result of the impermeability of the casing, smoke components in either gaseous or liquid form cannot penetrate the casing. Further, impregnation of thermoplastic casings with liquid smoke or other coloring additives has not been successful because thermoplastic casings do not adequately absorb and store impregnating agents. In order to impart a smoke color to thermoplastic-encased foodstuffs, it is necessary to remove the casing and apply an artificial color to the foodstuff, such as by spraying or dipping techniques, then repackage the foodstuff. These additional steps not only increase costs, but also increase the risk of food product contamination.

There is a recognized need in the art to provide a gas- and moisture-impermeable casing that can transfer browning and flavoring agents, such as a liquid smoke or other browning or flavor agent, to an encased foodstuff during cooking. However, to date, attempts to solve this problem and provide a commercially acceptable food product have failed for a variety of reasons. One approach was to blend a liquid smoke with a resin used for the inner layer of a plastic casing. This approach was unsuccessful for a number of reasons, including an insufficient transfer of the browning or flavoring agent to a meat surface, reaction and volatilization of the browning or flavoring agent at extrusion temperatures, and delamination induced by the presence of the browning or flavoring agent.

Another approach was to incorporate an absorbent browning or flavoring agent into the plastic casing. However, such a product has yet to be adopted commercially, and in practice it is believed that there is either an insufficient transfer of these agents from the casing to the foodstuff and/or insufficient retention of these agents on the surface of the casing.

A need still exists in the art for a composition that can be applied to a food packaging film in a sufficient amount to provide a desired golden brown color, and also being capable of transferring from the film to the foodstuff to provide the color.

SUMMARY OF THE INVENTION

The present invention is directed to compositions for application to a film used as a packaging material for a food product. The present invention also is directed to a food packaging film having a present composition applied to a food contact surface of the film. The composition is applied to a food contact surface of a food casing, and imparts an esthetic brown color to a foodstuff when the foodstuff is processed, i.e., cooked or otherwise heated, within the casing.

Therefore, one aspect of the present invention is to provide a composition for application to a film that can be used as a casing for a food product. The composition and treated film at least partially overcome the above-discussed disadvantages in browning a foodstuff, and provide a useful, commercial packaging material for a foodstuff.

Another aspect of the present invention is to provide compositions that can be applied to a film for use in encasing a foodstuff, and that effectively impart an esthetic brown color, and optionally flavor, to the cooked food product.

Still another aspect of the present invention is to provide a liquid composition for application to a food packaging film, said composition comprising:

- (a) about 20% to about 47%, by weight, of a browning agent;
- (b) about 0.05% to about 2%, by weight, of a viscosity-modifying agent;

(c) 0% to about 10%, by weight, of a surfactant, a polyol, or mixture thereof;

(d) 0% to about 3% of a pharmaceutically acceptable salt, e.g., sodium chloride; and

5 (e) water,

said composition having a pH of about 2 to about 6.5, and capable of transferring the browning agent of the composition from the food packaging film to a foodstuff packaged in the food packaging
10 film.

These and other novel aspects of the present invention will become apparent from the following detailed description of the preferred embodiments.

15 **DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS**

The present invention provides a film for use as a cook-in casing, wherein the film has a surface for contacting a packaged foodstuff. The film surface that contacts the foodstuff has a liquid
20 composition of the present invention applied thereon. Typically, the composition permeates the film, but may remain, at least partially, on the surface of the film.

The composition comprises one or more
25 browning agent, and an optional flavoring agent, for transfer to a packaged foodstuff. Prior to application of a present composition to the food contact surface of the film, the food contact surface preferably is subjected to a surface activation treat-
30 ment.

The present invention relates to the surprising and unexpected discovery that a liquid composition of the present invention can be applied to an activated or unactivated surface of a casing, and
5 the browning agent, and optional flavoring agent, can be effectively transferred to the encased foodstuff during heating or cooking. The composition effectively browns, and optionally flavors, the foodstuff to a consumer acceptable level.

10 In preferred embodiments, a present composition is applied to a film that has been surface activated prior to application of a present coating composition. The film activation process comprises
15 subjecting a surface of the film to a surface activation treatment, then applying a sufficient amount of a liquid composition of the present invention to the activated surface to impart a predetermined brown color and, optionally, flavor level to a foodstuff encased by, and cooked in, the film.

20 The film can be prepared from any material suitable for packaging food and in which a food contained therein can be cooked or heated. Cook-in films can be single or multilayer films. Multilayer films include a food contact layer and one or more
25 additional layers selected from sealant layers, abuse layers, bulk layers, oxygen barrier layers, moisture barrier layers, tie layers, and the like.

Persons skilled in the art are aware of suitable polymer materials and polymer blends for
30 use in the construction of cook-in films. Typical polymer materials known in the art include, but are

not limited to, polyolefins, such as polyethylene and higher alpha olefins, olefin copolymers with vinyl monomers, such as ethylene/vinyl acetate, ethylene/acrylic acid, or mixtures thereof. An
5 especially preferred polymer material is a hydrophilic material, such as a polyamide.

Polyamides are known in the food packaging art, and include, but are not limited to, aliphatic polyamides, such as condensates of aliphatic primary
10 diamines preferably having about 4 to about 8 carbon atoms, and aliphatic dicarboxylic acids preferably having about 4 to about 10 carbon atoms. An aliphatic copolyamide can be a homopolymer, or a polymer based on one or more aliphatic diamines and one
15 or more aliphatic dicarboxylic acids and/or one or more omega-aminocarboxylic acids or omega-aminocarboxylic lactams. Examples of suitable dicarboxylic acids include, but are not limited to, adipic acid, azelaic acid, sebacic acid, and dodecane dicarboxylic acid.
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The film also can include an additive to facilitate incorporation of a present coating composition onto or into the film. Suitable additives include, but are not limited to, water-soluble or
25 water-swellaable materials, such as a starch, a cellulose, e.g., alpha cellulose, a poly(ethylene oxide), a poly(vinyl alcohol), a polyacrylic acid, crosslinked polyvinylpyrrolidone (PVP), and copolymers or mixtures thereof. Preferred films contain
30 PVP or a mixture thereof.

The polymer used to manufacture the film also can be blended with additives that promote melt fracture or modify flow. In some instances, processing additives are added to control melt fracture. The levels of these additives are judiciously selected to provide the desired effect. Preferably, the film is heat-shrinkable under cook-in conditions such that the film conforms tightly to the cooked food product. Alternatively, the film can be shrunk prior to cooking by placing the package in a heated environment.

The surface of the film preferably is treated to increase the surface area of the film. Methods of surface treatment are known in the art and include ablation and etching. Alternatively, the surface can be roughened during extrusion by various methods, including extrusion through a roughened die or setting the melt and die temperatures to create a nonuniform or turbulent flow.

Typically, the film is in the form of a seamless tubular casing. Tubular casings are prepared by methods known in the art. Alternatively, the film can be formed as a single sheet, corona treated, coated with a composition of the present invention, and then formed into a tube by sealing the edges together. The process to form a single sheet into a tube by sealing is well known in the art as back seaming. Back-seaming is used on form and fill machines.

The film surface activation treatment can be any suitable treatment method, such as plasma,

flame, corona discharge, UV irradiation, electron beam irradiation, gamma irradiation, and the like. The film surface also can be treated chemically by subjecting the surface to oxidizing or etching agents. A preferred treatment is corona discharge as disclosed in U.S. Provisional Patent Application Serial No. 60/454,444, filed March 13, 2003 and in a U.S. patent application entitled "A Film Having a Liquid Absorbed Therein," filed on March 11, 2004, and incorporated herein by reference.

It is known to treat a polyolefin material by corona discharge to improve the wettability of the polyolefin surface. Typically the polyolefin is treated to increase the surface energy from about 30-32 dynes up to about 37-40 dynes. The power levels required to provide such increases in dyne level depend to some extent on the nature of the material to be treated and any additives therein, because different materials can respond differently. For example, polyesters require relatively low power levels of about 8 to 11 W-m/M², whereas polypropylene requires relatively high power levels of about 22 to about 27 W-m/M². Higher corona treatment levels are considered undesirable because it is believed a breakdown of the polymer surface occurs and low molecular weight products are released, which reduces the ability of the film surface to bond.

It also is known to treat a polyolefin layer that forms an interior surface of a tubular food casing by corona discharge. The corona discharge treatment improves the meat adhesion prop-

erties of the film surface. Typically, polyethylene is treated such that the surface energy of the film is increased to about 40 to about 50 dynes. A certain degree of adhesion to meat is desirable to
5 avoid a collection of juices between the meat and film package. Such a condition is known as "cook-out" or purge. However, excessive adhesion is undesirable because the film does not release cleanly from the meat surface, and a portion of the meat is
10 pulled away with the film. This results in a scarred and unsightly meat appearance.

Corona treatment of the interior surface of a tubular casing is described in U.S. Patent No. 5,296,170, incorporated herein by reference. Poly-
15 amide casing materials, which have a surface energy of up to about 45 dynes, generally have sufficient meat adhesion properties and corona treatment is not required. It is believed that if a polyamide is corona treated, then the resulting film would adhere
20 excessively to a meat surface, causing the above-mentioned problems.

The level of surface activation to which a film surface is subjected varies depending upon the identity of the film and the particular surface
25 activation treatment. The level of surface activation necessary for a particular substrate can be determined by a person of skill in the art by simple experimentation. Preferably, the surface is activated to a sufficient degree to retain a composition
30 of the present invention in an amount of about 0.1 to about 1.5, and preferably about 0.2 to about 1.3

mg/cm². To achieve the full advantage of the present invention, the film surface is activated to a sufficient degree to retain a composition of the present invention in an amount of about 0.3 to about 1.2
5 mg/cm² (milligrams of composition per square centimeter of film surface).

It should be understood that it is not necessary to activate the film surface before application of a present composition. A present composition
10 tion can be applied directly to an unactivated film. Persons skilled in the art are aware of the amount of present composition, i.e., about 0.1 to about 1.5 mg/cm², to apply to an unactivated film for retention, then transfer, of a browning agent to an en-
15 cased food product.

A present liquid coating composition comprises (a) a browning agent, (b) a viscosity-modifying agent, (c) an optional surfactant and/or a polyol, (d) an optional salt, and (e) water, and has
20 a pH of about 2 to about 6.5. The composition also optionally comprises a flavoring agent. The composition further can contain additional optional ingredients, such as a binder or gelling agent.

Preferably, for cook-in purposes, the
25 browning agent is a type that reacts with foodstuff proteins by a Maillard reaction and produces a brown color characteristic of smoked meat. Browning agents that react with proteins in this manner are active carbonyl compounds, such as, but not limited
30 to, aldehydes, e.g., hydroxyacetaldehyde, and reducing sugars, such as fructose, glucose, ribose,

lactose, xylose, and the like. A browning agent that is particularly useful is hydroxyacetaldehyde.

Preferred browning agents are liquid coloring agents available under the tradename MAILLOSE® from Red Arrow Products Co. LLC, Manitowoc, WI. MAILLOSE® contains hydroxyacetaldehyde, and is prepared from the pyrolysis of sugars and starches. Traditional liquid smoke products also are useful in a composition of the present invention. Liquid smoke is a collection of condensable products from the pyrolysis of wood or cellulose. Liquid smoke includes active carbonyl compounds as browning agents and further contains flavoring agents, e.g., phenols and acids. Liquid smoke is available under the tradename CHAR SOL®, from Red Arrow Products Co. LLC.

Preferred browning agents comprise a relatively concentrated amount of hydroxyacetaldehyde. Especially preferred is a browning agent comprising about 20 to about 47 wt%, preferably about 25 to about 40 wt%, and most preferably about 30 to about 35 wt%, hydroxyacetaldehyde.

Other optional browning agents unrelated to the pyrolysis of wood, cellulose, and starches can be used in addition to hydroxyacetaldehyde and a liquid smoke browning agent. These browning agents act as dyes to impart additional color to the cooked foodstuff. Such optional browning agents are well known in the art and include, but are not limited to, caramel, beet extract, malt, bixin, annatto, and mixtures thereof.

A present composition also includes at least one viscosity-modifying agent. Viscosity-modifying agents suitable for use in contact with food are well known in the art and include materials such as cellulosics and gums, like cellulose, methylcellulose, hydroxypropylcellulose, starch, chitin, carrageenan, konjac, guar gum, xanthan gum, alginic acid and derivatives thereof, agar, pectin, gelatin, and the like.

Preferred viscosity-modifying agents comprise a water-soluble cellulose ether including, but not limited to, methylcellulose, hydroxypropylmethylcellulose, hydroxypropylcellulose, ethyl methylcellulose, hydroxyethylcellulose, and ethyl hydroxyethylcellulose. More preferably, the viscosity-modifying agent comprises an anionic water-soluble cellulose ether including, but not limited to, carboxymethylcellulose and carboxymethyl hydroxyethylcellulose. Mixtures of water-soluble cellulose ethers also can be employed. Particularly preferred viscosity-modifying agents are the methylcellulose ethers sold under the tradename METHOCEL®.

Typically, a present composition includes up to about 2 wt%, preferably up to about 1 wt% of a viscosity-modifying agent. A more preferred composition includes about 0.05 to about 0.5 wt%, and most preferably about 0.10 and 0.25 wt%, of a viscosity-modifying agent.

A present composition optionally further includes one or more surfactant and/or polyol. Suitable surfactants are anionic and nonionic sur-

factants, including, but not limited to, calcium
stearoyl lactylate, a diglyceride, dioctyl sodium
sulfosuccinate, lecithin, a monoglycerides, poly-
sorbate 60, polysorbate 65, polysorbate 80, sodium
5 lauryl sulfate, sodium stearoyl lactylate, sorbitan
monostearate, or a mixture thereof. A preferred
polyol is propylene glycol, glycerol, or a mixture
thereof.

The surfactant, glycol, or mixture there-
10 of, in total, is present in the composition in an
amount of up to about 10 wt%, and preferably about
0.5 to about 8 wt%. To achieve the full advantage
of the present invention the total amount of surfac-
tant, glycol, or mixture thereof present in the com-
15 position is about 1 to about 5 wt%.

A present composition also optionally in-
cludes a pharmaceutically acceptable salt, e.g.,
sodium chloride, in a sufficient amount to approx-
imate the salt content of a foodstuff encased in the
20 casing. A salt typically is present in the composi-
tion in an amount of 0 to about 3 wt%, and prefer-
ably about 0.5 to about 2.5 wt%. To achieve the
full advantage of the present invention, the compo-
sition contains about 1 to about 2 wt% of a salt.

25 It is theorized, but not relied upon here-
in, that the salt, in some instances, helps mitigate
deep migration of the composition from the casing
into the interior of the encased foodstuff. In the
overall composition, it is important that the com-
30 position does not migrate deeply into the encased
foodstuff. By retarding migration of the composi-

tion into the encased foodstuff, the browning agent remains at or in the vicinity of the surface of the foodstuff and thereby provides a maximum brown color to the cooked or heated foodstuff.

5 A composition of the present invention is aqueous, and has a pH of about 2 to about 6.5, and preferably about 3 to about 6.5. To achieve the full advantage of the present invention, the composition has a pH of about 4 to about 6. The composition
10 tion pH therefore approximates the pH of the encased foodstuff, and reduces the problem of "purge" during cooking or heating.

 Therefore, an important feature of the present invention is to provide a composition for
15 application to a surface of a cook-in film comprising about 20 to about 40 wt% of a browning agent, preferably hydroxyacetaldehyde, up to about 2 wt% of a viscosity-modifying agent, optionally up to about 10 wt% of a surfactant, glycol, or mixture thereof,
20 optionally up to about 3 wt% of a salt, and having a pH of about 2 to about 6.5.

 An especially preferred composition includes about 20 to about 40 wt% hydroxyacetaldehyde in combination with a methylcellulose and a polyol,
25 such as propylene glycol, preferably up to about 10 wt%, more preferably up to about 5 wt%, polyol. A preferred composition also contains up to about 1.5 wt% of a salt, and a pH of about 4 to about 6.

 The composition optionally also can include
30 other ingredients, such as, but not limited to, antimicrobial agents, antioxidants, and stabil-

izers. An optional ingredient included in the composition is present in a sufficient amount to perform its intended function without adversely affecting the composition, film, or foodstuff.

- 5 The specific identity and amount of the individual components of the present composition are judiciously selected after considering the nature of the surface, the material of construction of the film, and the specific foodstuff to be packaged.
10. Consideration also is given to a desirable color or flavor profile of different meat products with a view to consumer acceptance.

 The level and rate of transfer of composition components from the film to the foodstuff can be influenced by the hydrophilic/lipophilic nature of the film surface, the specific composition, and the foodstuff. While not being bound by any theory, it is theorized that transfer of hydrophilic composition materials, e.g., browning agents, to a foodstuff having a relatively high water content (e.g., whole muscle products, like hams) is facilitated compared to a foodstuff having a relatively high fat content (e.g., some types of sausages). It also is theorized that composition transfer can be modified by the relative adhesion and retention of the composition to and in the film, and the absorbency of the composition into the foodstuff. For example, the present composition can be admixed with an edible oil prior to application to the film to reduce adhesion and improve absorbency.

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A present composition can be applied to a surface of the film by any suitable technique. One suitable, nonlimiting, process for applying a composition to a tubular casing is described in U.S.

5 Patent No. 3,378,379, incorporated herein by reference. This process is known in the casing art as slugging. The slugging method for application of a composition to the inside of a casing involves filling a portion of the casing with the coating material, such that the slug or coating material generally resides at the bottom of a "U" shape formed by the casing, and then moving a continuous, indefinite length of casing such that the slug of coating material remains confined within the casing, 10 while the casing moves past the slug and a present coating composition contained within the slug is applied to its inside wall. 15

A modified slugging process also can be used to apply a present composition to film surface, 20 wherein the slug is trapped between upper and lower pair of nip rolls. The upper set of rolls preferably includes a chrome roller and a rubber roller. The rubber roller typically has a hardness of between about 60 to about 120, typically between about 25 70 to about 100, durometer. As the tube passes between the two sets of rollers, the composition is carried with the film and the upper set of rolls act as metering rolls.

Preferably the gap between the roller is 30 set at less than the thickness of the film, typically at about 50%. This is in contrast to convention-

al application techniques where the gap is set equal to the film thickness plus the desired thickness of the coating layer. While not wishing to be bound by theory, it is believed that the pressure created as the film passes between the rollers assists in forcing the composition into the walls of the film. Typical levels of absorption are in the order of about 20 to about 28% by weight.

Food casings comprising a film coated with a composition of the present invention can be in any form known in the art, such as in the form of shirred casing sticks, discrete short segments of flattened casings, continuous lengths of flattened casing on a reel, and the like.

When the film is in the form of a tubular casing, the tube typically is shirred after application of the present coating composition. Shirring can be accomplished by conventional shirring techniques well known to persons skilled in the art.

Another important feature of the present invention is to provide a shirred tubular food casing having an interior food contact surface having a liquid composition of the present invention applied thereto for transfer to a foodstuff encased therein. Prior to application of the composition to the surface, the surface preferably is subjected to a surface activation treatment.

After a present composition is applied to the film, the film can be used as a casing for a food product. When the film is in the form of a tubular casing or a shirred casing, the casing can

be stuffed by pushing a meat product through a stuffing horn into the inside of the tubular casing.

Another important feature of the invention is to provide a method of processing, e.g., cooking or heating, a food product comprising packaging a foodstuff within a film treated with a composition of the present invention, then heating the packaged foodstuff for a sufficient time and at a sufficient temperature for components of the composition to transfer to a surface of the foodstuff and impart a brown color to the foodstuff.

As demonstrated hereafter, it is preferred that a foodstuff is heated or cooked as soon as possible after encasing the foodstuff in a film having a present composition applied thereto. It has been found that browning of the cooked or heated foodstuff is maximized when the encased foodstuff is cooked or heated as soon as practical after encasing.

A foodstuff packaged within the film can be cooked by any suitable method, such as boiling, heating by steam, or in an oven. Preferably, the packaged foodstuff is cooked as soon as practical after packaging. As illustrated hereafter, the brown color imparted to the foodstuff is optimized when the encased foodstuff is processed within four hours, preferably within two hours, and more preferably within one to one and one-half hours after packaging. Processing shortly after packaging fixes the browning agents at or near the surface of the foodstuff, and foodstuff browning is not diminished

because of browning agent migration deeper into the foodstuff.

Alternatively, the food product can be subjected to a preheating step to transfer the components of the composition to the foodstuff and fix the color prior to cooking. For example, the packaged foodstuff can be preheated to a temperature of about 150°F to about 200°F for a period of up to about 6 minutes. During cooking or preheating, the browning agent of the present composition imparts an esthetic color to the surface of the food.

Example 1 Coating Compositions

Coating compositions of the present invention were prepared according to Table 1 by admixing composition components.

TABLE 1		
Composition No.	Composition (wt%)	Meat and Cooking Variables
C _{3/02}	MAILLOSE® 45 ¹⁾ 94.63	Uniform surface color. No purge. ΔL=7.7
	Propylene Glycol 5.00	
	Diethyl Sulfosuccinate 0.25	
	Xanthan Gum 0.12	
C ₁	MAILLOSE® 45 ¹⁾ 94.50	Uniform surface color. No purge. ΔL=9.9
	Propylene Glycol 5.00	
	Diethyl Sulfosuccinate 0.25	
	Xanthan Gum 0.25	
C ₂	MAILLOSE® 45 ¹⁾ 94.50	Purge heavy when product held prior to processing. Color splotchy.
	Propylene Glycol 5.00	
	Diethyl Sulfosuccinate 0.25	
	Xanthan Gum 0.25	
C ₃	WFE ²⁾ 94.00	Purge heavy when product held prior to processing. Color splotchy.
	Propylene Glycol 5.00	
	Xanthan Gum 0.30	
	Konjac Gum 0.20	
	METHOCEL® E-15 0.50	
C _x	WFE ²⁾ 94.75	Slight purge when product held prior to processing.
	Propylene Glycol 5.00	
	Diethyl Sulfosuccinate 0.25	

TABLE 1		
Composition No.	Composition (wt%)	Meat and Cooking Variables
		sing. $\Delta L=7.88$
C ₄	WFE 94.875 Propylene Glycol 5.000 Xanthan Gum 0.125	Very splotchy color.
C ₅	WFE 94.875 Caramel Color 5.000 Propylene Glycol 5.000 Xanthan Gum 0.125	Very splotchy color.
C ₆	MAILLOSE [®] 45 94.75 Propylene Glycol 5.00 METHOCEL [®] SG A16M 0.25	Heavy gelatinous purge.
C ₇	MAILLOSE [®] 45 94.875 Propylene Glycol 5.000 METHOCEL [®] SG A16M 0.125	Uniform surface color. Dry surface. $\Delta L=13.9$
C ₈	WFE 94.75 Propylene Glycol 5.00 METHOCEL [®] A16M 0.25	Heavy gelatinous purge.
C ₉	WFE 94.875 Propylene Glycol 5.000 METHOCEL [®] SG A16M 0.125	Uniform color. Dry surface. $\Delta L=19.1$
C ₁₀	WFE 94.94 Propylene Glycol 5.00 METHOCEL [®] SG A16M 0.06	Uniform color. Dry surface. $\Delta L=5.65$
C ₁₁	R26 RTP ³⁾ 94.875 Propylene Glycol 5.000 METHOCEL [®] SG A16M 0.125	Uniform color. Dry surface.
C ₁₂	WFE 84.875 Caramel 10.000 Propylene Glycol 5.000 METHOCEL [®] SG A16M 0.125	Uniform color. Dry surface. Caramel added for staining power to darken.
C ₁₃	RA 9751 ⁴⁾ 94.875 Propylene Glycol 5.000 METHOCEL [®] SG A16M 0.125	Dry surface. Very splotchy pH 12.5 liquid smoke for staining/-color development.
C ₁₄	WFE 97.375 Propylene Glycol 2.500 METHOCEL [®] SG A16M 0.125	Uniform surface color. Dry surface. $\Delta L=6.34$
C ₁₅	WFE 92.44 Propylene Glycol 7.50 METHOCEL [®] SG A16M 0.06	Splotchy color. Surface dry.
C ₁₆	WFE 92.44 Glycerol 7.50 METHOCEL [®] SG A16M 0.06	Splotchy color. Surface dry.
C ₁₇	WFE 94.875 Glycerol 5.000 METHOCEL [®] SG A7C 0.125	
C ₁₈	WFE (42% HA) 94.875 Propylene Glycol 5.000 METHOCEL [®] SG A16M 0.125	Dark, dull brown. Dry surface. Splotchy. Vis-

TABLE 1		
Composition No.	Composition (wt%)	Meat and Cooking Variables
		cosity too high to uniformly coat.
C ₁₉	WFE (47% HA) 94.875 Propylene Glycol 5.000 METHOCEL® SG A16M 0.125	
C ₂₀	MAILLOSE® 45 98.4 Propylene Glycol 1.4 METHOCEL® K 100M 0.2	Uniform mahogany color. Dry surface.
C ₂₁	WFE 98.4 Propylene Glycol 1.4 METHOCEL® K 100M 0.2	Uniform mahogany color. Dry surface.
C ₂₂	WFE (42% HA) 100.0	Uniform brown color. Dry surface. Casing splotchy. Viscosity too high.
C ₂₃	MAILLOSE® 45 99.75 Xanthan Gum .25	
C ₂₄	WFE (70 Brix) 94.8 Propylene Glycol 5.0 METHOCEL® K 100M 0.2	
C ₂₅	WFE (70 Brix) 94.875 Propylene Glycol 5.000 METHOCEL® SG A16M 0.125	Splotchy, no purge, $\Delta L=12.51$
C ₂₆	MAILLOSE® 45 97.20 METHOCEL® K100M 0.35 Propylene Glycol 2.45	
C ₂₇	WFE ²⁾ 94.875 METHOCEL® SG A16M 0.125 Propylene Glycol 5.0	Splotchy, some purge, $\Delta L=14.41$
C ₂₈	WFE ²⁾ 94.814 METHOCEL® SG A16M 0.186 Propylene Glycol 5.0	Uniform color, no purge, good casing to meat adhesion, $\Delta L=10.63$
C ₂₉	WFE ²⁾ 94.78 METHOCEL® SG A16M 0.22 Propylene Glycol 5.0	Splotchy, slight purge, $\Delta L=13.35$
C ₃₀	WFE ²⁾ 94.875 METHOCEL® K 100M 0.125 Propylene Glycol 5.0	Very splotchy, excess purge, $\Delta L=14.12$
C ₃₁	WFE ²⁾ 94.814 METHOCEL® K 100M 0.186 Propylene Glycol 5.0	Uniform color, slight purge, $\Delta L=11.76$
C ₃₂	WFE ²⁾ 94.78 METHOCEL® K 100M 0.22 Propylene Glycol 5.0	Very splotchy, excess purge, $\Delta L=14.94$
C ₃₃	WFE ²⁾ 94.625 METHOCEL® SG A16M 0.125 Diethyl Sulfosuccinate 0.250 Propylene Glycol 5.000	Uniform color, slight purge, $\Delta L=11.23$

TABLE 1		
Composition No.	Composition (wt%)	Meat and Cooking Variables
C ₃₄	MAILLOSES 45 94.875 Propylene Glycol 5.000 METHOCEL® SG A16M 0.125	Slightly splotchy, good casing to meat adhesion, ΔL=17.01
C ₃₅	WFE ²⁾ 92.875 Propylene Glycol 5.000 Sodium Chloride 2.000 METHOCEL® SG A16M 0.125	Very splotchy, purge moderate, ΔL=11.06
C ₃₆	WFE ²⁾ 94.75 Propylene Glycol 5.00 Dioctyl Sulfosuccinate 0.25	Difficult to shirr. Slightly splotchy, no purge. ΔL=11.41
C ₃₇	WFE (pH 5.5) ²⁾ 94.875 Propylene Glycol 5.000 METHOCEL® SG A16M 0.125	Splotchy surface, no purge, ΔL=12.37
C ₃₈	WFE (70 Brix) 94.625 Propylene Glycol 5.000 Dioctyl Sulfosuccinate 0.250 METHOCEL® SG A16M 0.125	
C ₃₉	MAILLOSE® 45 94.625 Propylene Glycol 5.000 Dioctyl Sulfosuccinate 0.25 METHOCEL® SG A16M 0.125	

1) MAILLOSE® 45 contains 27 wt% hydroxyacetaldehyde, and is available from Red Arrow Products Co. LLC, Manitowoc, WI;

5 2) WFE contains 35.4 wt% hydroxyacetaldehyde (HA) and is available from Red Arrow Products Co. LLC, Manitowoc, WI;

10 3) R26 RTP contains 8.7 wt% hydroxyacetaldehyde and is available from Red Arrow Products Co. LLC, Manitowoc, WI; and

4) RA 9751 is free of hydroxyacetaldehyde and primarily is a stain for foods (pH 12.7), available from Red Arrow Products Co. LLC, Manitowoc, WI.

15 A preferred composition contains about 90 to 97 wt% WFE or MAILLOSE® (65 brix) for maximum browning and optimum solids, about 5 wt% propylene glycol for METHOCEL® hydration and ease of peeling, about .125 wt% SG A16M METHOCEL® for water binding, 20 viscosity control, and surface tension control, about 2 wt% sodium chloride to normalize the composition with meat-free water and thereby minimize

composition/color migration and to reduce METHOCEL gel temp, and pH 5 by the addition of a sufficient amount of sodium hydroxide (NaOH) or phosphate to minimize protein syneresis and purge.

5 **Example 2 Corona Treatment of a Polyamide film**

 The following tests were performed on a three-layer heat-shrinkable tubular film having an outer polyamide layer, an intermediate polypropylene copolymer layer, and an inner polyamide layer. The
10 inner layers were subjected to a pretreatment to provide an irregular surface morphology.

 The tubular film was internally corona treated at 600 watt 13.6 kilovolt using an electrode apparatus similar to that described in U.S. Patent
15 No. 5,296,170, wherein one of a pair of electrodes is placed in contact with one side of an inflated tube. In this way, a corona discharge is generated in the air space within the tube. However, a significant difference between the method described in
20 U.S. Patent No. 5,296,170 is that in the present example, much higher power levels are used. Although U.S. Patent No. 5,296,170 does not disclose the power level in watt density, the examples show an increase in dyne level of a polyethylene film
25 from 31 dyne to 42 and 41 dyne. However, it can be estimated from this change in dyne level that the power level is about 18 and 23 watt. In order to provide for the significant increase in power level for the present process, two electrode treater

stations were mounted in series. The total power was split equally between the two stations.

After corona treatment, the interior surface of the film was coated by slugging as described in U.S. Patent No. 3,378,379 and summarized below:

1. The tube is slit open and an amount or "slug" of the coating is added;

2. Air is injected to form the tube into a cylindrical shape and the slit is sealed with a tape;

3. The tube is advanced through, and partially collapsed through, a set of coating rolls. The spacing between the coating rolls is adjustable such that the rolls are not totally closed. As the film with the coating passes through the rolls; most of the liquid is squeezed out; and

4. The film with the coating on the inside surface is then wound into reels.

Three coating trials were conducted with varying levels of corona treatment followed by coating under identical conditions of speed, nip roll gap, and nip roll structure. The level of surface activation was estimated by measuring the surface energy in dynes. The results are summarized in Table 2. The composition used was Composition No. C₁, the components of which are set forth in Table 1.

TABLE 2					
Corona Treatment	Dyne Level	W-min/cm ²	Line Speed (fpm)	Add-on ¹⁾ mg/cm ²	Increase %
No	52	0	45	0.40	0
Yes	58	78	45	0.46	15
Yes	66-70	228	45	0.67	67.5

¹⁾ The amount of coating composition retained was measured by weighing the film before and after coating.

5

The results summarized in Table 2 show a 67% increase in the amount of composition that can be absorbed into the inner layer of the casing, and the amount of coating composition retained on the inner surface of the film directly correlates to the level of corona treatment, as measured in dynes.

The dyne levels in Table 2 are well in excess of that achieved by corona treatment used to facilitate meat adhesion, i.e., between 40 to 50 dynes provide acceptable meat adhesion. It is generally accepted in the art that if films are treated to a dyne level above about 50 dynes, then the film unduly adheres to the meat surface. In the present invention, it was surprisingly observed that despite these high levels of surface activation, the composition-treated film unexpectedly released cleanly from the meat surface without meat scarring.

In the experiments it was observed that the surface activation was sufficiently high such that the dyne level was outside of the usual dyne measurement techniques. For this reason, the level of surface activation was estimated in terms of watt density.

Watt density is calculated according to the following formula:

$$\text{Watt density} = \frac{\text{power supply (watts)}}{\text{tube width(M)} \times 2 \times \text{line speed (min/M)}}$$

The width of tube was multiplied by two to account
5 for the fact that the tube is double sided. Such a correction would not be necessary for a single sheet film.

To further demonstrate the amount of composition that can be absorbed into a polyamide film
10 is a function of the corona treatment, the film used in the tests of Table 1 was treated at two different corona levels. Moisture then was applied to the film and the amount of moisture absorbed was determined per ASTM 570. This test requires specimens to
15 be conditioned in an oven for 24 hours at 50°C cooled in a desiccator, then immediately weighed to the nearest 0.001 g. After conditioning, the test specimens were immersed in distilled water that was
20 maintained at room temperature (23°C ± 1C°) for 72 hours. At the end of the test, the specimens were removed from the water, all surface water was wiped off with a dry cloth, then the specimen was weighed immediately to the nearest 0.0001g.

To calculate the percentage increase in
25 weight during immersion, the following equation was used:

$$\text{Increase in weight, \%} = \frac{(\text{Wet weight} - \text{Initial weight}) \times 100}{\text{Initial weight}}$$

Table 3 summarizes the results of the test. The results indicate that the amount of moisture that is absorbed increases as the corona level is increased.

Table 3			
Test		% Weight Gain	W-m/M ²
1	no corona	12.9	--
2		14.7	About 75
3 ¹⁾		18.7	189.3

¹⁾ For test 3, the inner surface was further treated to the level indicated. It is estimated that the dyne level is 70 or higher at the watt density indicated, but at these levels the dyne test cannot be used with any reliability.

To demonstrate that a present composition is absorbed when applied to the inner surface of the film, the following test was devised:

Film samples were cut to fit circular hoops similar to those used to hold cloth when doing needle point. The inner surface of the film was placed in the hoop so that the rim of the hoop and the film formed a container. Before the film was clamped into the hoop the thickness of each film specimen was measured to the nearest 0.0001 in using a linear gauge. All test specimens were conditioned in an oven for 24 hours at 50°C and cooled in a desiccator. The film specimens then were clamped into the hoops.

A solution containing MAILLOSE® (C20) was added to the inner surface of a film of the structure polyamide/tie/polyamide. This film is referred

to here after as V9. The MAILLOSE® solution was added to just cover the surface of the film. This method insures that only the inner surface of the film has solution applied, and closely simulates the slugging process.

Excess MAILLOSE® solution was poured from the hoop, the specimens were removed from the hoop, then all surface solution was wiped off with a dry cloth. The specimen was cut into 3 pieces, then weighed immediately to the nearest 0.0001 g. All film specimens were then reconditioned for the same time and temperature as used in the original drying period (24 hours at 50°C) and weighed to the nearest 0.0001 g.

Table 4 summarizes the results obtained for this test. It can be seen that the amount of composition add-on increased with an increase corona treatment. These results show that the corona treatment, as measured in watts per minute per m², considerably increases the level of coating composition that can be applied to the film.

TABLE 4		
Material	Treatment w-min/m ²	Absorption %
V9-control	0	23.9
V9-50	50	28.6
V9-100	100	30.4
V9-150	150	37.0
V9-200	200	33.1
V9-250	250	32.2
V9-300	300	30.6
V9-400	400	30.1
V9-500	500	31.4

Example 3 Shirring, Stuffing, and Processing

Films were coated with the above coatings as described in Example 2. The coated films, after allowing time for the coating to adhere and/or be absorbed onto the rolls, were shirred into "sticks." Shirred tubular casings are prepared by conventional shirring machines known in the art. Ham or turkey meat products then are pushed through a stuffing horn into the shirred casings.

10 The encased food products then were cooked in an oven for a sufficient time for the food product to reach an internal temperature of 160°F. The oven was maintained at 100% relative humidity and a temperature of 185°F. Cooking was conducted as soon as practicable after stuffing. Controls were conducted in the absence of corona treatment and coating.

The results are summarized in Table 5.

TABLE 5									
Inner Layer	Coating Type	Colorant	Treatment W-min/m ²	Add-on mg/cm ²	Product Type	Colorimetric Values			
						L	a	b	ΔL
LLDPE	None	None	None	None	Turkey	71.43	5.70	8.80	--
Nylon	C ₉	Liquid Smoke	205.8	.94	Turkey	56.55	11.47	22.40	14.88
LLDPE	None	None	None	None	Ham	65.35	12.02	9.72	--
Nylon	C ₉	Liquid Smoke	169.8	.90-1.00	Ham	50.36	14.91	23.70	14.99
LLDPE	None	None	None	None	Ham	65.69	11.86	5.59	--
Nylon	C	MAILLOSE®	196	.42	Ham	62.45	11.86	19.84	3.24
Nylon	C ₆	MAILLOSE®	61.2	.56	Ham	59.01	12.90	21.26	6.68
LLDPE	None	None	None	None	Turkey	74.14	5.19	8.32	--
Nylon	C	MAILLOSE®	196	.42	Turkey	69.49	9.78	27.35	4.65
Nylon	C ₆	MAILLOSE®	61.2	.56	Turkey	62.40	10.93	27.02	11.74
LLDPE	None	None	None	None	Turkey	75.1	N/A	N/A	--
LLDPE	C	MAILLOSE®	300	.42	Turkey	73.4	N/A	N/A	1.7
Nylon	C	MAILLOSE®	300	.42	Turkey	67.4	N/A	N/A	7.7

L value--The lower the number, the greater the color density
a value--The higher the number, the more intense a red hue
b value--The higher the number, the more intense a yellow hue
LLDPE --Linear low density polyethylene

Both the ham and turkey products cooked in the treated film have a uniform, smoked brown color. The uniform color of the foodstuff indicates that a composition of the present invention is uniformly
5 coated on the film, and that this uniform coating is resistant to disruption by shirring and stuffing procedures. A composition of the present invention also has sufficient flexibility to stretch during stuffing and shrink during heat-shrinkage of the
10 film. Still further, there is no evidence of purge or cook-out, or an unacceptable adhesion of the film to the foodstuff.

Accordingly, a surface treated film can retain a composition of the present invention in a
15 significantly greater amount than an untreated film. Further, a surface treated film can be shirred and stuffed by conventional shirring and stuffing procedures.

Example 4

20 Tests were performed to demonstrate that a composition of the present invention, after application to a corona-treated casing, retards migration of the browning composition into an encased foodstuff. In particular, compositions C₂₅ through C₃₇,
25 and a control, individually, were applied to a corona-treated casing. Then, the casing was stuffed with chunked and formed ham using a Tipper RS4202 apparatus. The resulting foodstuffs were metal molded and hot water cooked at 165°F. The results
30 in Table 6 illustrate that a present composition

remains at or in the vicinity of the surface of a cooked foodstuff, thereby maximizing the brown color of the foodstuff surface.

TABLE 6	
Composition	Penetration (mm)
C ₂₅	2
C ₂₇	2
C ₂₈	1.5
C ₃₁	1.5
C ₃₄	1.5
C ₃₅	1
C ₃₆	2
C ₃₇	2-3

5

Example 5

Tests also were performed to demonstrate that cooking immediately after stuffing provides a deeper, more esthetic golden brown color. A foodstuff was encased in a corona discharge treated casing as set forth below. The treated casing had a composition of the present invention applied there-
to.

The encased food products were cooked by heating in an oven, with steam or hot water, set for a length of time for the product to reach an internal temperature of 160°F. The oven was maintained at 100% relative humidity and a temperature of 185°F. The steam and hot water temperatures are noted in the following table. Cooking was conducted either as soon as practicable or at various times after stuffing as noted.

Foodstuff	Coating	Inner Layer	Colorimetric L Value	Comments
Turkey	None (Control)	LLDPE	74.6	Product held before processing
Turkey	C _{3/02}	Nylon	72.93	Processed after stuffing
Turkey	C _{3/02}	LLDPE	73.97	Held 4.5 hours
Turkey	C	Nylon	70.07	Processed immediately
Turkey	C	Nylon	73.56	Held 4 hours
Turkey	C ₁	Nylon	67.55	Processed immediately
Turkey	C ₁	Nylon	73.26	Held 4 hours
Turkey	C _x	Nylon	69.55	Processed immediately
Turkey	C _x	Nylon	73.75	Held 4 hours
Turkey	C ₂	Nylon	66.33	Processed immediately
Turkey	C ₂	Nylon	61.48	Held 4 hours
Turkey	C ₃	Nylon	66.57	Processed immediately
Turkey	C ₃	Nylon	66.27	Held 4 hours
Turkey	C ₁	Nylon	67.55	Processed immediately
Turkey	C ₁	Nylon	73.26	Held 4 hours
Turkey	C ₁	Nylon	61.67	Processed immediately
Turkey	C ₁	Nylon	64.51	Held 4 hours

It will be appreciated that various changes and modifications may be made to the invention described herein without departing from the spirit and scope thereof.